



CIMAC

THE INTERNATIONAL COUNCIL ON COMBUSTION ENGINES



What is gas and how do we use it profitably?

Wilhelm Müller

Amsterdam, 09 June 2015





PowerGen – Amsterdam Future Gas Variation and the (financial) consequences

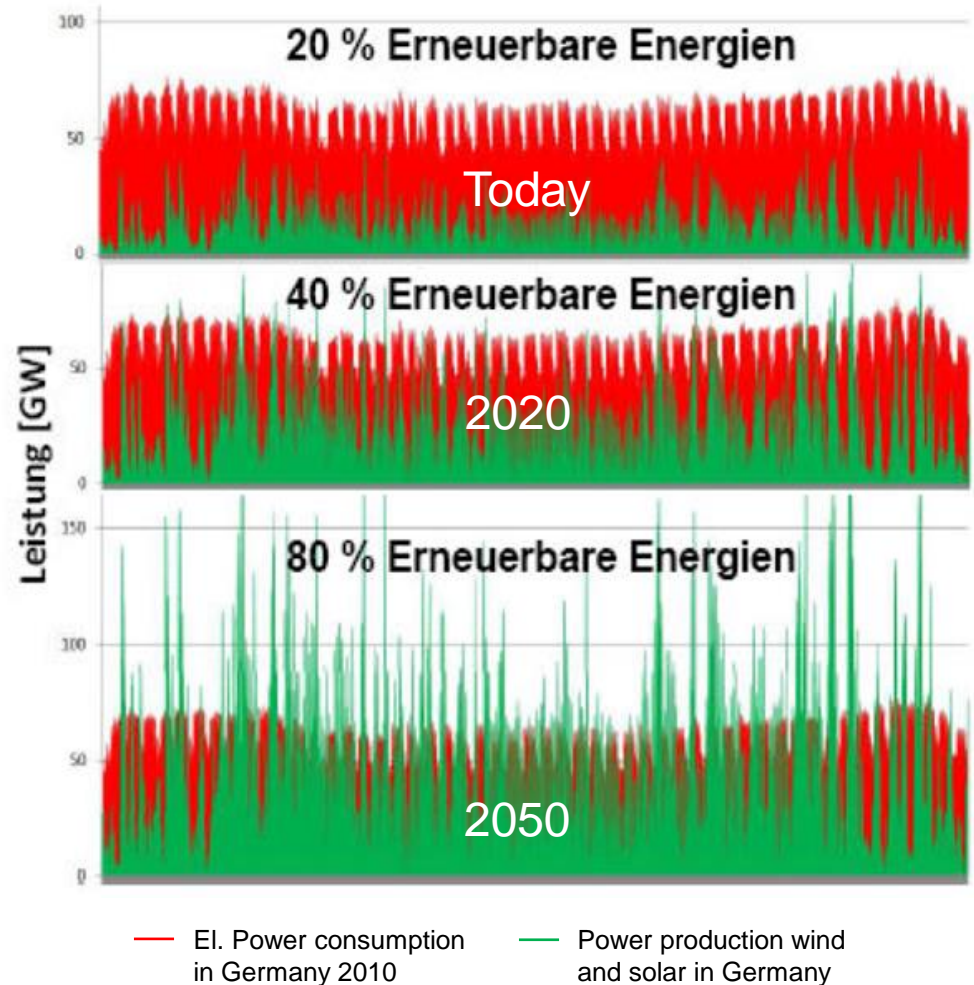
Wilhelm Müller
June 9th 2015

CATERPILLAR®
Electric Power Division

Covering the German “Energiewende” with gas-gensets

Goals of the German “Energy revolution”:

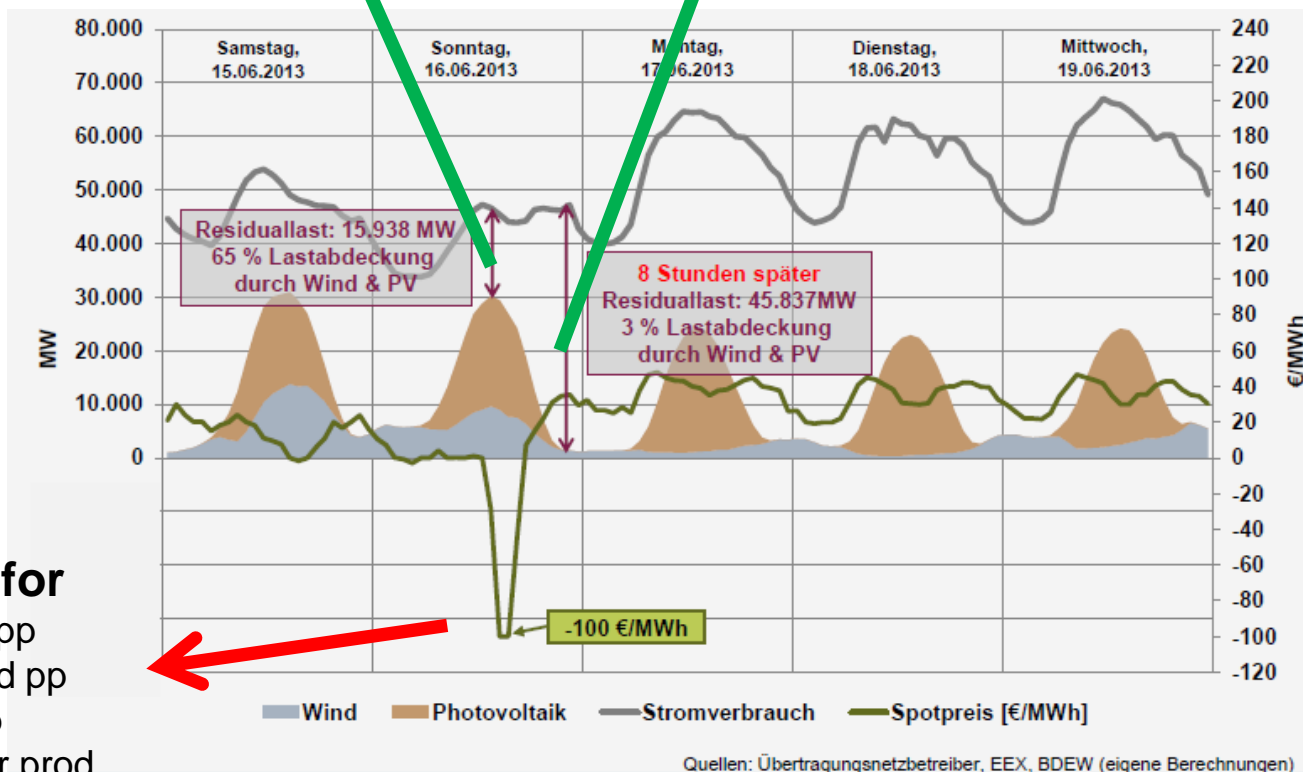
- Shutdown nuclear power plants
- Security of energy supplies executed with renewable energies
- Reducing environmental impact and reach CO2 targets
- Safety and cost-efficient energy supply



Source: Weissmüller, DEEnO 2014

Volatile electricity - Temporary overproduction and deficit

Operation area of CHP with gas engines on/off

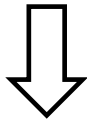


Problem for

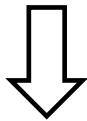
- Nuclear pp
- Coal fired pp
- Large pp
- All power prod.

Approach to use overproduction

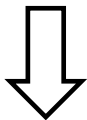
Overproduction of
electrical energy



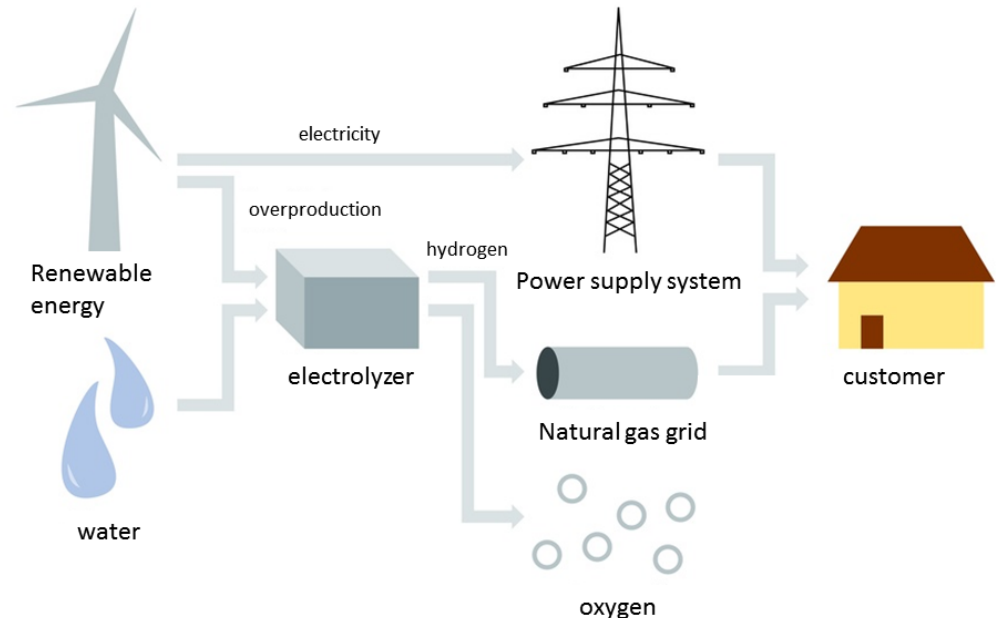
Production of hydrogen and
supply to the natural gas grid



Hydrogen gas mixture
to be used for
energy deficit phase



Consequences
(for IC engines, ...) ?



picture: thingamajigs/fotolia

LNG supply routes for Europa

Flüssigerdgas (LNG)

für Europa

Mrd. m³/a

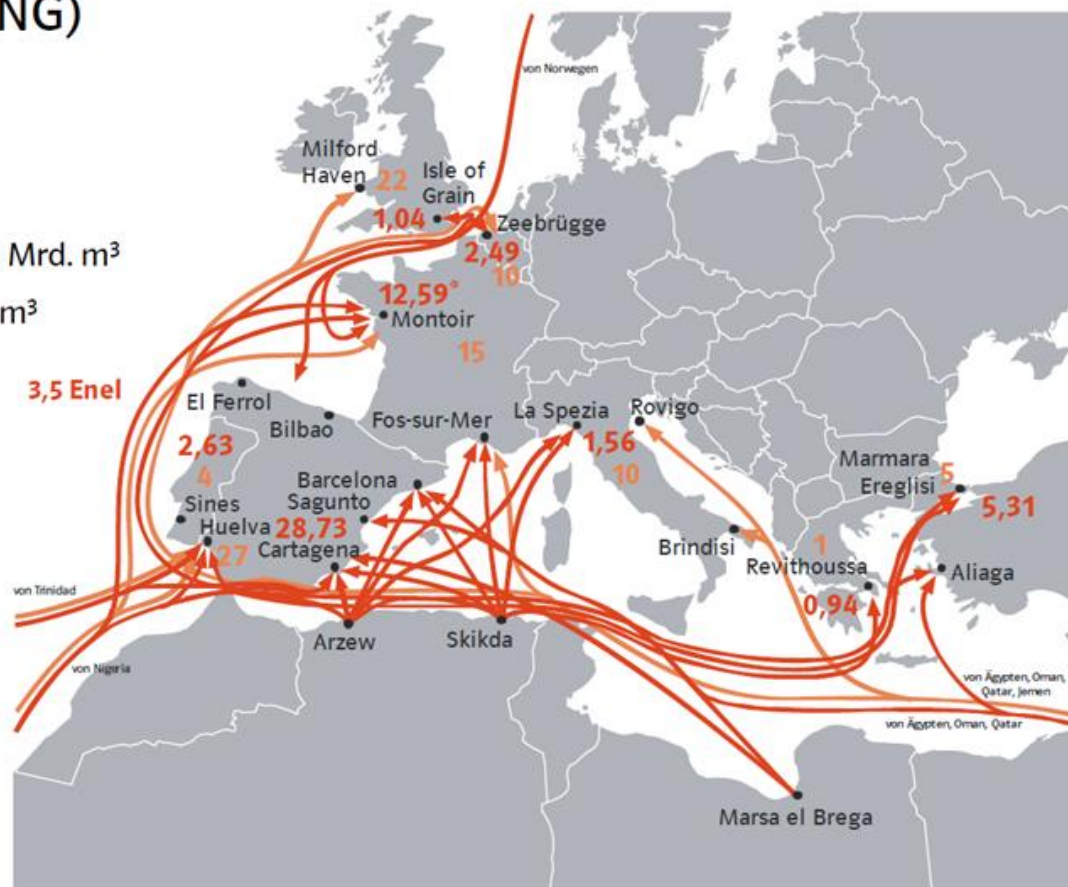
— Lieferungen 2008 : 55,3 Mrd. m³

— Importe 2010 : 94 Mrd. m³

davon

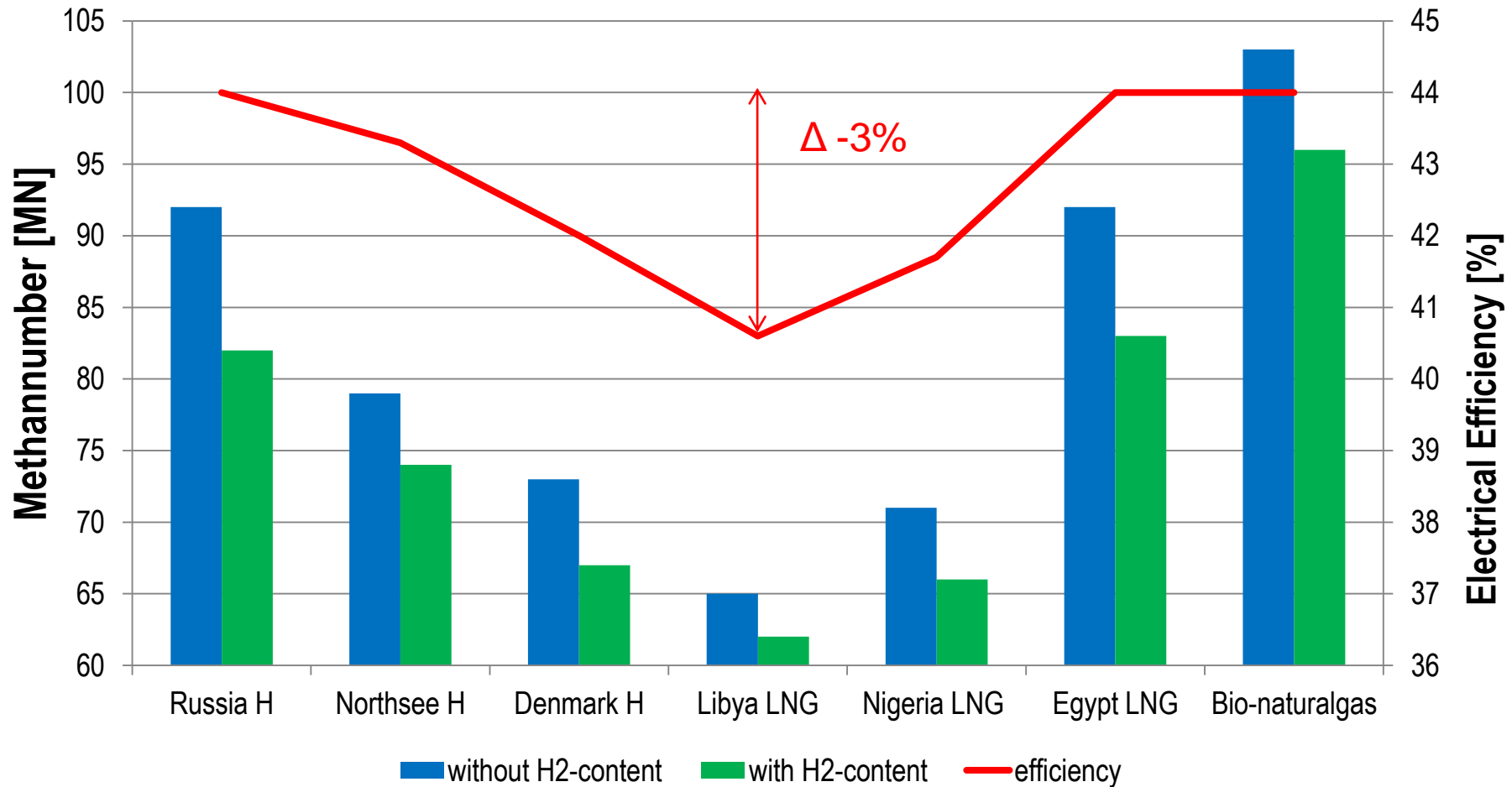
Algerien	19,38
Ägypten	6,37
Qatar	7,89
Oman	0,17
Trinidad & Tobago	5,03
Libyen	0,53
Nigeria	14,63
Norwegen	1,38
Äquat. Guinea	0,08

Quelle: Cedigaz
* davon 3,5 Mrd. m³/a aus Nigeria
über Montoir für Enel / Italien

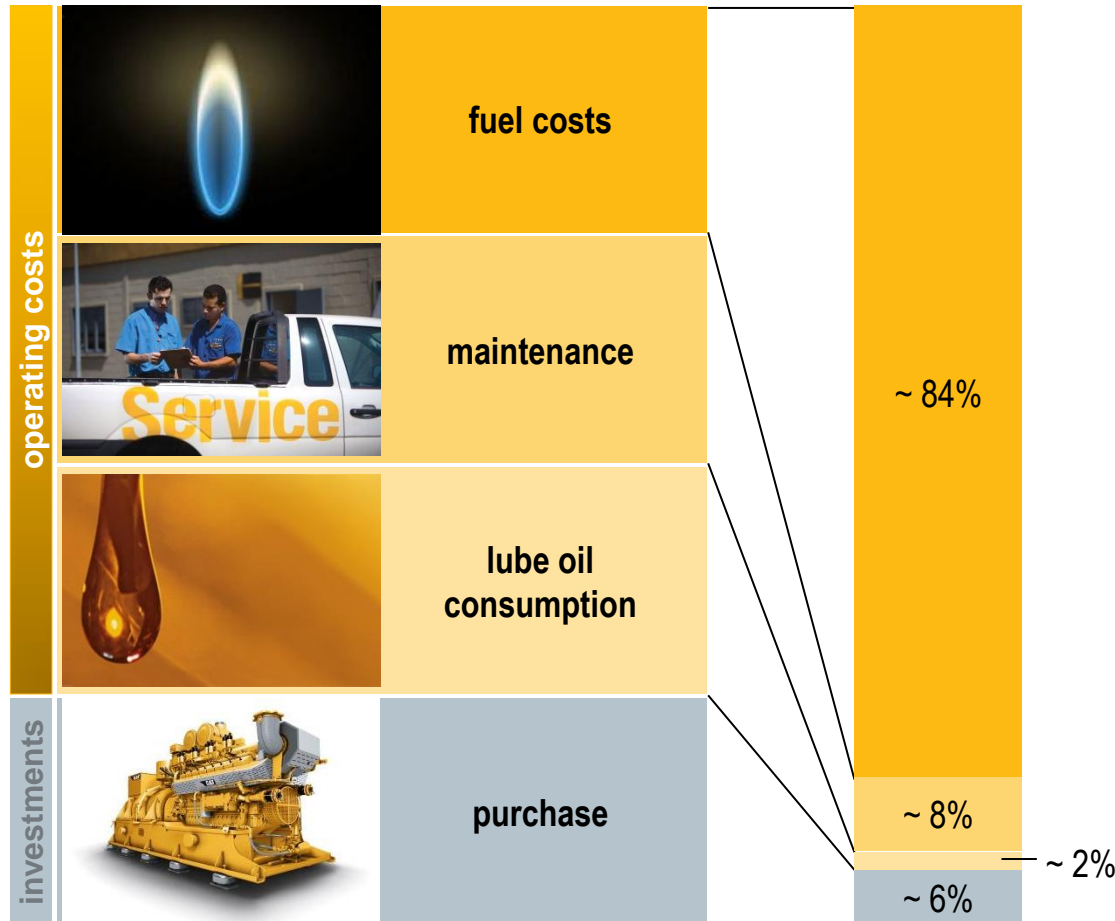


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Comparison MN impacted by 10% hydrogen



Total cost of ownership



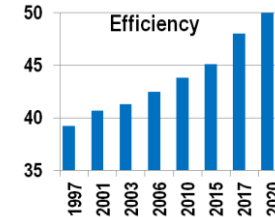
Life cycle costs greatly depend on engine gas costs, therefore **engine / genset / power plant efficiency** is very important.

The impact of gas quality has an impact on engine efficiency and total cost of ownership.

Key aspects of the gas engine development

- Increase of engine efficiency
- Increase of power output

Economic efficiency



- Reduction of exhaust emission
- Reduction of noise

Environmental protection



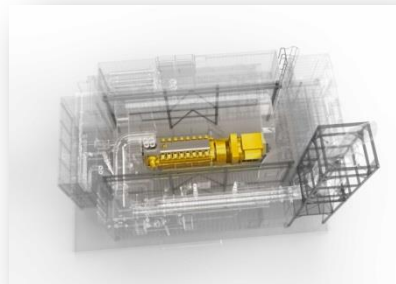
- Gas engine modification to fulfill the requirements for flexible plant operation
- Gas engine modification to operate with varying gas qualities
- Optimization of control strategy

Reliability



Resume

- The energy transition will have a dramatic influence on the energy spot prices
- Flexible power plants are necessary to adjust fluctuating energy from wind and photovoltaic
- Power producers have to deal with new challenges by switching on/off power plants or implementing new solutions with new specifications and intelligent controls
- Future open gas market has an influence on gas quality
- Energy storage is the new challenge
- Electricity grid and gas distribution system might no longer be independent
- Complete solutions have to be created, including gas engine technologies and control systems to fulfill the future challenges for total cost of ownership
- **Caterpillar is offering solutions for all required specifications**



Caterpillar Energy Solutions

One powerful future.



Thank You For Your Attention!

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